regard to the powder called B.N. You will remember that in the early stages of motion it gave velocity to the shot much more rapidly than did the other powders. You see the effect in the pressure curves, the maximum being considerably higher than any of the other pressures, while the pressure towards the muzzle is, on the other hand, considerably below the average.

I fear you may think I have kept you unnecessarily long with these somewhat dry details, but I have had reasons for so doing.

In the first place I desire to demonstrate to you the enormous advances which have been made in artillery by the introduction of the new explosives, and which we in a great measure owe to the distinguished chemists and physicists who have occupied themselves with these important questions.

Secondly, I desire to show you that the explosive which has been adopted by this country, and which we chiefly owe to the labours of Sir F. Abel and Prof. Dewar, is in ballistic effect inferior to none of its competitors. I might go further and say that it is decidedly superior.

Lastly, at a time when the efficiency of all our arms, and especially our artillery, is a question which has been deeply agitating the country, I may do some good by pointing out that the authorities are well aware that any practicable velocity or energy they may desire for their guns is at their disposal.

They have such guns, I mean guns with high velocity and high energy—whether they have enough of them, and whether they are always in the right place, is another matter, for which perhaps the military authorities are not altogether responsible. But velocity and energy is not the only thing that is required under all circumstances in war, and I ask you to believe that if the War Office authorities have, for their field guns, fixed on a velocity very much below what is possible, they have had sound and sufficient reasons for so doing.

My firm and I, individually, have had much to do with the introduction of the larger high-velocity and quick-firing guns into our own and other services; but as an old artillery officer, in no way responsible for our field guns, I may perhaps be allowed to say that, whether as regards materiel or personnel, our field artillery is inferior to none anywhere; and I venture to add that in the present war it appears to have been handled in a way worthy of the reputation of the corps.

I fear the causes of some of our military failures at the commencement of the war must be looked for in other directions, and the present unfortunate war will turn out to be a blessing in disguise, if it should awaken the Empire to the necessity of correcting serious defects in our organisation, possibly the natural result of our constitution; and, in that case, the invaluable lives that have been lost will not have been sacrificed in vain.

(*To be continued.*)

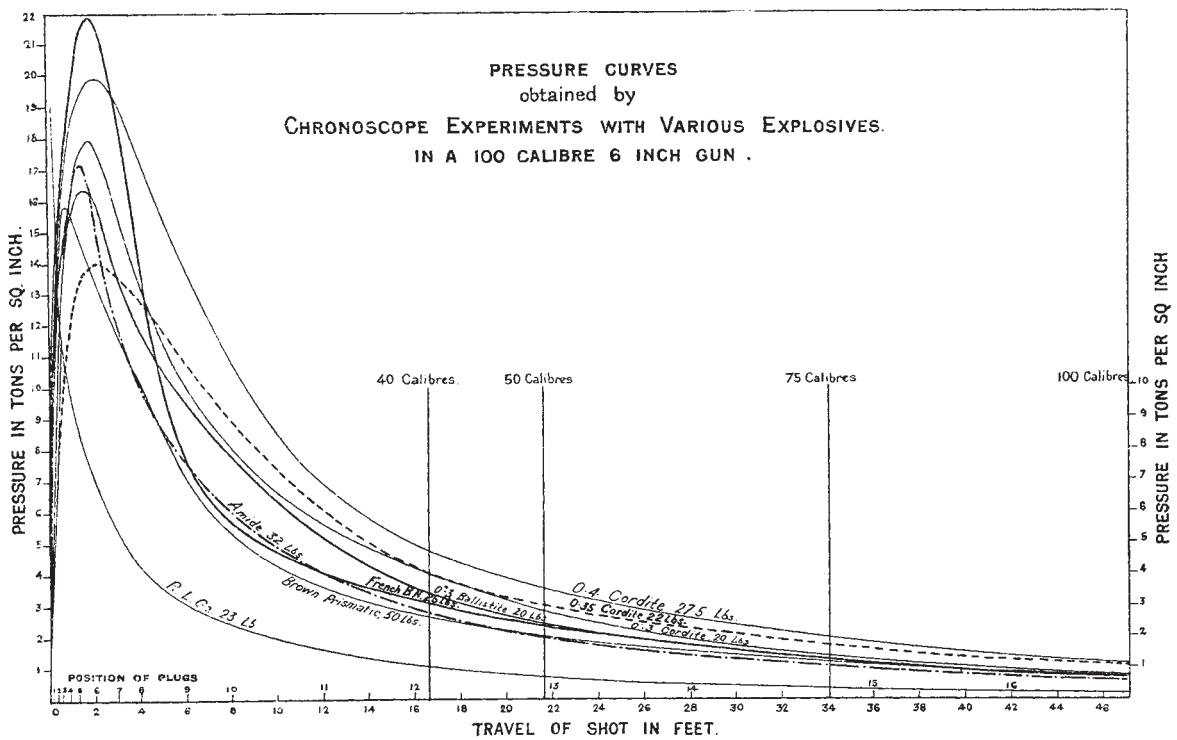


FIG. 3.

THE USE OF STEEL IN SHIPBUILDING.[1]

MANY changes and developments in the construction of ships for the mercantile marine have taken place during the last forty years. At the commencement of this period wood was still the principal material employed for shipbuilding, and although iron had been introduced for general shipbuilding purposes some twenty years earlier, the record of new tonnage added to the British Register in 1860 shows only about 30 per cent. to have been built of iron.

The general adoption of iron for shipbuilding on the Wear dates from about the year 1863, and by 1880 it had, in that district, entirely taken the place of wood. On the Clyde, Mersey and Tyne, iron shipbuilding was adopted at an even earlier date. So far back as 1855, iron had largely taken the place of wood for shipbuilding on the Clyde.

The difficulty of preventing the fouling of the bottoms of iron ships due to corrosion or marine growths, and the consequent loss of speed, led to various attempts being made to sheath the bottoms of iron ships and cover the wood sheathing with copper, yellow metal, or zinc sheets. The result was the introduction of the system of construction known as "Composite," in which the framing was of iron, with wood planking wrought on the iron frames, and sheathed with copper or yellow metal.

[1] Abstract of a paper read before the Institution of Naval Architects by Mr. B. Martell.

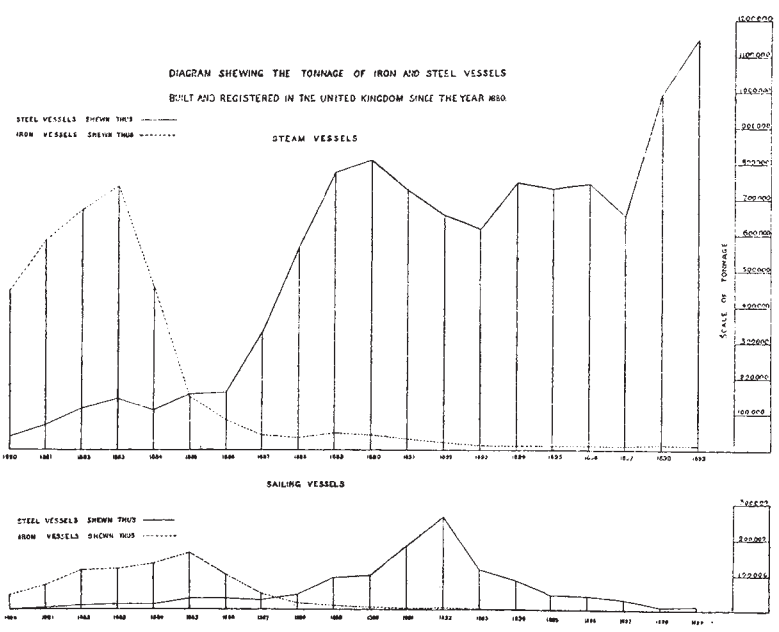
The early composite ships were classed as experimental, and subject to biennial survey, in order that the condition of the fastenings might be examined, and the effects of the galvanic action set up by the iron framing and yellow metal sheathing ascertained from time to time.

So far back as 1862, applications were made for vessels to be classed which were to be built with puddled steel, but in the absence of experience regarding the durability of steel, the Committee of Lloyd's Register felt it was not in their power to sanction the proposal.

In 1864, however, a steam yacht of 2400 tons was built for the Viceroy of Egypt under the survey of Lloyd's Register Surveyors, and constructed partly of steel. A reduction of about one-fourth was allowed in the steel scantlings from those required for an iron ship of the same size.

In April, 1876, Mr. James Riley, then manager of the Siemens Steel Works at Landore, read a paper before the Institution of Naval Architects on the production of mild steel, setting forth the results of experiments that had been made with steel manufactured by the Siemens-Martin or open hearth process, and showing the qualities of this material as to ductility and tensile strength.

These results were placed before the Committee of Lloyd's Register, and in 1877 plans from Messrs. J. Elder & Co. were approved for the construction of two paddle steamers to be built of this material for the English Channel service, with a reduction of about 20 per cent. in the scantlings which had been adopted for iron vessels.



In the same year, in consequence of a report which may be found in the volume of *Transactions* of this Institution for 1877, it was decided to admit steel with scantlings 20 per cent. lighter than prescribed for iron, in vessels building for classification, subject to the material having a tensile strength of from 26 to 30 tons per square inch, and an elongation of 20 per cent. on a length of eight inches. These limits of tensile strength have since been raised to 28–32 tons.

The progress in the use of mild steel for shipbuilding purposes may be judged from the fact that while in 1878 seven steel vessels, of 4470 tons, were classed in Lloyd's Register, and 435 iron vessels, of 517,692 tons, the record for the year 1885 showed 118 steel vessels, of 165,437 tons, as compared with 260 iron vessels, of 290,429 tons. As wood was superseded by iron as a material for shipbuilding, so in its turn iron has given place to steel. Of the total output of the United Kingdom during the past year, 98·8 per cent. of the tonnage was built of steel, and 1·1 per cent. of iron. The iron tonnage was principally made up of trawlers, and comprised no vessel of more than 303 tons.

The accompanying diagram shows the relative changes in the tonnage of steamers and sailing vessels of iron and steel built and registered in the United Kingdom since 1880.

Soon after the introduction of mild steel for shipbuilding purposes, attention was given to the making of heavy steel castings to take the place of iron forgings for stern frames, rudders, propeller brackets, stems, quadrant tillers, &c. These castings are required to be subjected to certain tests, and at the present time are often adopted in place of iron forgings.

It may be here remarked that, notwithstanding the early doubts as to the durability of steel, experience has shown that where proper care is taken to thoroughly clean and paint the surfaces, the deterioration is not appreciably greater than that of iron. In some parts, however, such as thin deck plating, and plating of inner bottom and floors under boilers, steel appears to be more liable to deteriorate, and in consequence of this, iron is often used for these parts in vessels otherwise constructed of steel.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—An appointment will ere long be made to the new Wykeham professorship of physics, which will be endowed in accordance with statute by New College. It is understood that a portion of the space to be vacated in the University Museum by the removal of the Radcliffe Library will be utilised, at least temporarily, as a laboratory for the teaching of electricity.

Merton College proposes to contribute, out of its University Purposes Fund, the sum of 700*l.* towards the cost of fitting up, and 500*l.* towards that of maintaining for two years, the new electrical laboratory, provided that no further liability be hereby undertaken by the College. This proviso is intended to guard against the College University Purposes Fund being regarded as a permanent source of income. Messrs. W. Peterson, principal of McGill University, and John Fletcher, professor of Latin in the University of Toronto, have been appointed as representatives of the University at the centenary of the University of New Brunswick, and Mr. W. R. Morfill, reader in Russian, has been appointed representative at the five-hundredth anniversary of the University of Cracow.

The statute making the degrees of B.C.L. and D.C.L. accessible to persons who have obtained a degree in arts in other Universities, and study law in Oxford although they have not been admitted to the degree of B.A., has been approved by Congregation and Convocation; and also the decree instituting the new research degrees of Doctor of Letters and Doctor of Science.

It is proposed that the necessary qualification for intending candidates for the diploma in Geography shall be that candidates give satisfactory evidence that they have received a good general education, and not, as at first suggested, that they should have passed the examination for the B.A. degree.

On May 22 the honorary D.C.L. degree was conferred upon the following colonial representatives:—The Hon. Alfred Deakin, the Hon. James R. Dickson, C.M.G., and the Hon. Sir Philip O. Fysh, K.C.M.G.

The 212th meeting of the Oxford University Junior Scientific Club was held on Friday, May 11. Papers were read by Mr. S. A. Ionides, Balliol, on "Microphotography," and by Mr. P. Elford, St. John's, on "Chemists of the Nineteenth Century." The following papers will be read during the course of the present term:—"Musical Tetanus," Prof. Sir John Burdon Sanderson, F.R.S.; "The Labile Hydrogen Atom," Mr. A. F. Walden, New College; "A Method for Measuring the Diameter of the Earth," Rev. T. C. Porter.

CAMBRIDGE.—Dr. J. W. L. Glaisher, F.R.S., has been appointed by the council of the Senate a governor of St. Paul's School.